MONONGAHELA INCLINE PLANE
Connecting the north side of Grandview Avenue
at Wyoming Street with West Carson Street
near Smithfield Street
Pittsburgh
Allegheny County
Pennsylvania

HAER No. PA-226

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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HISTORIC AMERICAN ENGINEERING RECORD

MONONGAHELA INCLINE PLANE HAER No. PA-226

LOCATION: Monongahela Incline Plane, connecting the north side of Grandview Avenue at Wyoming Street with the south side of West Carson Street near Smithfield Street, Pittsburgh, Allegheny County, Pennsylvania

DATE OF CONSTRUCTION: 1870, passenger incline plane; 1882, freight incline plane

ENGINEER: John J. Endres

PRESENT OWNER: Port Authority of Allegheny County
Beaver and Island Avenues
Pittsburgh, PA 15233

PRESENT OCCUPANT: Port Authority of Allegheny County
Beaver and Island Avenues
Pittsburgh, PA 15233

PRESENT USE: Passenger transportation between West Carson Street near Smithfield Street and Grandview Avenue, Mount Washington

SIGNIFICANCE: The first constructed and oldest passenger incline plane in Pittsburgh, this system retains the 1882 safety brake and bull wheel and 1935 electrical system including drive motors, operating brakes and power cable system.

PROJECT INFORMATION: The documentation of the Monongahela Incline Plane was undertaken in January-June, 1993, to mitigate the adverse effect of planned changes to the transportation system. This documentation was stipulated by the State Historic Preservation Officer as part of a Memorandum of Agreement. Documentation has been prepared by Rebecca M. Rogers, Historic Preservation Consultant, 44 Audubon Road, Youngstown, Ohio 44514. The project team included: Rebecca M. Rogers, architectural historian, and David Thum, photographer.

The Monongahela Incline Plane is a transportation system now owned by the Port Authority of Allegheny County. It connects Carson Street, near the Smithfield Street Bridge, on the south side of the Monongahela River with Grandview Avenue on the northern edge of Mount Washington in Pittsburgh, Pennsylvania. This incline plane consists of two parallel steel rail tracks on the Mount Washington escarpment that carry two cars up and down the hillside between an upper station (1882) and a lower station (1904). The incline plane system runs approximately north and south, with the lower station on the north end and the upper station on the south end. The road bed is 365' long. An electric elevator-type motor system powers the incline plane (1935). The cars are pulled by steel cables. A secondary cable and brake system insure safety (1882). This was the first passenger incline plane constructed in Pittsburgh and is one of five passenger incline planes still operating in the United States.

A passenger incline plane is a large example of the simple machine as defined in physics, used for transportation of goods or persons. For this unusual transportation system, a hillside is the wedge or angle of the mechanical tool. The "pull" comes from an engine or motor and the counterweight of a car running on a parallel track down the hillside. A steel cable acts as the rope connecting the up and the down cars.

The present Monongahela incline plane system consists of the two cars, the track and the cable dependent on a motor drive system designed and manufactured by Otis Elevator Company in 1935. The system moves the cars by the friction of the cable's contact with two drive wheels driven by two electric motors. The entire drive system is housed in the basement of the upper station. The steel cable is attached to the uphill end of the bottom of each car and passes from each car into the motor room below the upper station waiting room floor. The steel drive cable and safety cables are 1-1/4" diameter stranded steel over an independent wire rope core. The cable from each car moves on a cast steel "deflector sheave" 7' in diameter. A deflector sheave is similar to a pulley wheel with two grooves. The inside groove carries the drive cable and the outside groove carries the safety cable. Two additional 7' in diameter deflector sheaves are mounted at a slight angle, nearly vertical, in direct line with each of the two incline plane tracks. Each is mounted above one of the motors in the motor room. Each of these deflector sheaves directs the drive cable to one of two drive sheaves mounted vertically, below, and nearly 90 degrees crosswise to the deflector sheaves, in a pit at the far south side of the motor room. The hub of each drive sheave is connected directly to a herringbone drive gear. The herringbone drive gear is driven by a herringbone pinion gear which is in direct line with a spring loaded brake and 250 volt, direct current motor, shunt wound. The 7' diameter cast steel drive sheaves have spiral grooves

allowing two wraps of the cable, moving it by the friction of double wrap of cable on the grooves.

The power is supplied from public service entry on the southeast corner of the upper station. Power to the system is furnished through a 75 motor-generator running at 1200 revolutions per minute, supplying 240 volts of direct current to the motors. The drive system is basically the same as an elevator drive system. The motors are mounted in line with the steel cable connected to the incline plane cars just beyond and slightly below the end of the incline plane track. Speed is increased or decreased according to the voltage applied to the motor. When the power is cut, the cars stop. Between each motor and its drive wheel is the brake. Braking is accomplished by cutting the power to the motor through a spring loaded arm. Above and between the motors is a governor switch that controls the drive speed, engaging the brake if the motor exceeds an acceptable limit.

The safety braking system for the incline plane was designed by Samuel Diescher and installed in 1882 beneath the upper end of the incline plane track just outside the upper station. It is protected from the weather by the roof overhang. This system consists of a cable attached to each car, a 10' diameter cast iron wheel, and an air brake. The brake wheel or "bull wheel" is supported by an iron truss which is hung from the main center rail truss by three steel plates. The south end of the center rail truss is supported by a 28" steel I-beam supported between the two projecting bays of the upper station. The bull wheel truss is supported on a stone and concrete foundation on the north and hung from the 28" steel I-beam and the center rail truss on the south. The 15" deep bull wheel truss is made of parallel iron 7-1/2" "C-shaped" channels, with two upper chord channels and two lower chord channels. The bull wheel sits parallel to the plane of the track between the top and lower chord of the truss. The bull wheel is cast in two hemispheres which are bolted together. The entire wheel has six spokes that support a 10" wide outer rim with a 4" upper groove for the safety cable and a 4" lower channel for the steel brake band with brake shoe lining. The safety cable is attached to the bottom of each car, like the drive cable. It passes from the car to the outer groove of the deflective sheave, then to the upper groove of the bull wheel, across the second deflective sheave and to the other car. The safety brake is activated by an air cylinder with a piston 12" diameter and 15-1/2" long. The control for the safety brake is in the operator's cabin which is called a "pulpit". Air lines run from the pulpit to the air cylinder.

Also located on the support truss for the bull wheel is the take-up for expansion and contraction of the safety cable. This system also dates from 1882 with a later electric motor to operate the gears. The system has a leather belt from the motor

to turn steel gears mounted on the end of the bull wheel truss. These gears operated screw adjustors which are mounted in long steel tubes running parallel to the chords of the bull wheel support truss. The screw adjustors move the bull wheel north or south, lengthening or shortening the distance the steel cable moves. The cable lengthens when the temperature is hot, shortens when the temperature is cold. Cable also stretches as it wears, requiring constant adjustment.

The operation of the incline plane is controlled from the pulpit located on the main floor of the upper station directly above and at the end of the incline plane track. The drive panel for the Otis Elevator motors is located here as is the control for the safety brake system. The operator, once called "the engineer," has television contact with the lower station, installed in the late 1960s, as well as audio contact and telephone contact. Telephone, audio and television contact is carried in conduit on the east side of the incline plane track.

The incline plane cars run on steel rails laid on 8" x 8" wooden ties. The ties are laid on steel work supported by concrete piers designed by the Pittsburgh firm Acres American Incorporated and constructed by another local business Massaro Corporation in 1982. The cables for the drive system of the incline plane and the safety system are carried on the incline plane bed on 10" diameter cast steel idlers mounted in pairs with two sheaves; the inner sheave is for the drive cable and the outer sheave for the safety cable. These wheels are mounted on 23" long steel straps bolted to the ties.

Port Authority of Allegheny County designed and fabricated the two incline plane car bodies in 1982 to be similar to the bodies they replaced; the bottom carriages of the old cars were rehabilitated by Hail Industries at the same time. Each car has three passenger compartments seating eight persons. The compartments are arranged in step-like levels with each compartment floor 4'-2" higher or lower than the adjacent compartment floor. The bottom carriage of the car is at the angle of ascent, 37 degrees. The two lower compartments are enclosed and glazed; the upper compartment is open with an iron grille instead of windows. Each car rolls on four 16" diameter wheels. The cars weigh 7 tons each and can carry a three ton load.

The hip roof two-story Second Renaissance Revival style lower station was designed by the Pittsburgh firm of MacClure and Spahr in 1904. The construction drawings are housed at Port Authority of Allegheny County Records and the specifications are at the Archives of Industrial Society, University of Pittsburgh Library. The 42'-4" x 40'-8" building faces south, directly onto the sidewalk of West Carson Street. The wood and steel frame

building is covered in common bond wire-cut red brick laid with butter joints. It has no basement or water table but has a five-coursed belt course marking the second floor. The first floor has rusticated piers between the five front bays and on the first bay of the east side. The front second story has five front bays each with recessed flat space divided by brick quoins. The front facade is symmetric with a center door, flanking windows and corner bay doors. The center bay wooden doorway is a replacement with an original round arch transom, sandstone keystone and header course brick band. The second-story center recessed space has a window with soldier course jack arch and sandstone keystone, 10/1 double-hung wooden sash. The flanking bays have round arch first floor windows with sandstone jack arches like the center doorway, 10/10 double-hung sashes and jack arches with keystones double-hung 8/1 windows above. The corner bays have doorways on the first floor (once double doors with single glass panels) and double-hung 4/4 windows with jack arches and sandstone keystones on the second floor. Above the second floor corner windows are ornamental foliate swags. The southeast corner projects slightly as the intended first pier of elaborate brick and iron entry gates to the freight incline plane that were never constructed. The east side is distinguished by jack arch and sandstone keystone windows, 8/1, not aligned, and the belt course. The west facade has an addition to accommodate wheelchair access to the incline plane cars; this houses an elevator. This windowless bay has the same rusticated brick treatment as the front piers and a parapet that repeats the belt course detailing. The asphalt hip roof has exposed wooden rafters, "4 x 8s", heavily shaped, with a flush-board soffit. The rear gabled dormer with green asphalt shingle pediment covers the incline plane cars and is open on the south. Similar green shingles cover the lantern of the square, then octagonal, louvered cupola. The cupola dome and lightening rod are copper. The west side has a red wire-cut brick chimney 52" x 24" with a molded sandstone cap and a brick corbel band below the cap. The exterior brick and sandstone have been painted to tie the later additions to the original structure.

The lower station interior closely resembles the original although the waiting room has been renovated. The waiting room has a concrete floor covered in asphalt tile, beaded board wainscotting and plaster walls. The original metal ceiling in the waiting room, second floor office and exterior covered car entryway was supplied by S. Keighley Metal Ceilings & Manufacturing Company in 1904. It has a coved foliate wall-edge "cornice", wall-edge band and center detail for each installation. The south wall of the waiting room is glazed above the wainscotting to give a view of the incline plane cars. The west and east side car access halls are similar with 5" tongue-and-groove ship-lap siding and five steps to each car compartment doorway. The doors, 6'-6" x 2'-3", to the cars are glazed with

arched top windows and three wooden panels below. The middle west car access door is enlarged to accommodate handicap access. Access to the second floor is by stairs on the east wall beyond the entry to the cars. This hall has beaded board wainscotting, a metal ceiling and a wooden balustrade with plain square balusters and molded railing and molded balustrade floor sill. The second floor is unaltered with the directors' meeting room across the front and a southeast corner room for a safe, sink and desk. The front rooms are three structural bays wide, divided by ceiling arches with pressed metal ceiling panels. The meeting room has original yellow pine varnished trim 5" wide and mitered at the corners with bottom "plinths" for both doors and windows. The yellow pine varnished doors have five panels and plain brass knobs with rectangular plates. The windows are double-hung with chains and pulleys and have two stamped brass lift plates for each lower sash. All the windows are yellow pine with 1" muntin bars and have a yellow pine molded apron below each sill. A bank of three 10/1 windows face the track. The 7" yellow pine base-board is plain with a 1" quarter round at the wall junction and at the floor edge. The floor is 2-1/4" tongue-and-groove oak with some plywood patches. The central decorative element of the meeting room is a west-end projecting fireplace with a 38" x 31-1/2" opening. The hearth and the opening surround are red terra cotta 4" x 1" tiles laid with butter joints. The fireplace 4" wide molding with plinth and 4" deep, 8" wide mantle shelf are varnished yellow pine. The room has original foliate cast iron radiators and two original iron safes manufactured by the Pittsburgh Safe Company.

A later brick and concrete block, one-story building addition, 20'-8" x 10'-0", houses maintenance south of the lower station and below and behind the incline plane track.

The upper station of the Monongahela incline plane dates from 1882. The one-story building, 40'-6" x 40'-6", has a low pitched gable roof facing directly onto the sidewalk of Grandview Avenue. The building is one room deep with two north wings, 10'-1" x 14'-0", that give access to the cars. The roof covers the space between the two projecting bays. The exterior of the building is much altered with "board-and-batten" siding made of metal, six angle brackets made of "4 x 4s" with chamfered members and scalloped barge boards. The original front had clapboard walls, board-and-batten pediment, angle brackets that projected beyond the narrow rake boards and a collar and post pediment detail that was flush with the rake boards. Of the original five front openings, three remain. The center front doorway with sidelights and panels below is an alteration. The flanking two front window openings are original, but the window sill height was raised in 1982. The present siding on the west and east sides obscures two original window openings on each side. The building foundation is coursed rubble sandstone. The roof is asphalt shingles, once

a standing seam metal roof.

On the interior, the main floor waiting room reflects much of the original interior character with 7" double molded, mitered window and door jambs, 3" vertical beaded board wainscot, 36" high and dry wall above. All doors are not original. A lavatory has been added to the southeast corner. The east doorway and east and west windows have been removed. The interior finishes for the entrances to the cars are not original, but have wainscot similar to that in the waiting room. The pulpit, directly in front of the front door and overlooking the end of the track, is raised with glazing facing the waiting room and facing the track. The basement is accessed by steel winding stairs on the northeast side of the waiting room. It houses the motor room under the waiting room and work rooms under the north projecting bays that are entrances to the cars. In the motor room, the 18' x 7'-6" pit for the drive wheels is centered against the south exterior wall. The power entry is in the southeast corner with direct current conversion and switches along the east wall. The drive motors and brakes are centered between the pit and the end of the track. The bull wheel is between the two work rooms, under the track.

East of the upper station are the remnants of the freight incline plane: concrete and sandstone piers for the trestle work. North and below the grade of Wyoming Street is a concrete pad with generator to provide power is case of electric utility interruption.

Prior to 1865, incline planes in the United States were used to move industrial goods at the Portage Railway of the Pennsylvania Public Works rail-canal system and in many coal mines. In 1868, John J. Endres, a civil and mining engineer, submitted a plan to a group of men from Pittsburgh to construct an incline plane from Mount Washington to the south side of the Monongahela River. This new transportation system would make the residential land at the top of the Mount Washington escarpment more accessible to persons working in Pittsburgh and on the south side of the Monongahela River. Prior to 1870, Mount Washington was accessible only by stairs or a narrow, steep and muddy path cut into the hillside near the south end of the Monongahela Suspension Bridge.

At the end of the Civil War, Pittsburgh industries largely consisted of blast furnaces, rolling mills, coke batteries, foundries, glass houses and allied manufacturing that produced great quantities of heat, smoke and soot. The topography of the city, with three large rivers, infrequent bridges, narrow bottom lands and steep river banks, confined residential areas to the densely packed, smoky land adjacent to local industries. Prior to construction of incline planes in Pittsburgh, all workers and

most shop keepers and other business men were confined to living within walking distance of their work, about a mile, as no other systems of transportation existed. Mount Washington rose next to the Monongahela River, within one half mile of the river bank. The bank escarpment was so steep that little smoke and soot blew onto the land, yet the climb up the hillside was so difficult that the community of Mount Washington had few streets and was largely occupied by large residential lots. Construction of an incline plane not only provided a large area for more pleasant residential neighborhoods, it offered Mount Washington land owners profits from subdivision of the large residential tracts.

At the founding of the Monongahela Incline Plane Company in 1867, no particular route for the incline had been chosen. The initial survey by J. L. Kirk suggested two sites, the "southern site," where the incline was constructed, and the "western site," later to become the location of the Duquesne Incline, opened in 1877. Each was chosen for the consistency of the grade along the entire route, the stability of soil, the need for minimal movement of soil and the proximity to a bridge across the Monongahela River. The southern route was chosen because it was accessible to a larger population and more industries than the western route. Further, the site crossed land owned by a founding director, William M. Lyon, who charged $1 per year rent of the right-of-way.

The initial plan for the incline plane, conceived by Endres, called for two 5' gauge, iron T rail tracks, weighing 40 pounds to the yard, made by Jones & Laughlin, a Pittsburgh manufacturer. The track bed extended 635' up the hillside, making the ascent of 370' on a 35 degree, 35 minute grade. A wooden trestle supported most of the track, making the road bed level. An iron bridge made by the Iron City Bridge Company, J. C. Schultz designer, carried the track over the Pittsburgh, Cincinnati, Chicago and St. Louis (later Panhandle division of the Pennsylvania Railroad) Railroad. A heavy wooden ladder was attached to the trestle between the two tracks so that the road bed and trestle could be inspected and repaired. A 1-1/2" steel cable composed of seven strands, nineteen wires per stand, making one turn in 10-1/2", raised and lowered the cars on the road bed. The cable was designed to sustain 35 tons of vertical lift. The safety cable, or "drag cable," was 1-1/8" diameter. These cables were supported by wooden rollers called "sheave wheels" placed at intervals along the track. The pull cable attached to each car was wound around a "huge and massive" cable drum of unspecified size. As each cable drum rotated, one pull cable wound up its cable drum and the other pull cable wound off its drum. This gave uphill motion to the first car and downhill motion to the second car. The contemporary description does not describe whether the two cable drums had grooved iron beds to supported each turn of the cable or were made of smooth wood or some other

non-abrasive material. The two steam engines had a 12" cylinder and either a 20" or 24" stroke. They were joined in a "cross link system," that combined the drive force so that both engines worked simultaneously to drive the system (People's Monthly). J. & J. B. Milholland of Pittsburgh built the steam engines of Sligo boiler plate iron manufactured across Carson Street from the incline plane (American Street Railway Association and Industries of Pittsburgh). These engines could go forward or backward and were governed by a hand throttle and a foot brake. The boilers were manufactured by W. Douglass & Sons Bridge & Boiler Works, located across Carson Street from the lower station, east of the Sligo rolling mill.

The steam engines, drive system and boilers were housed in a two-story brick boiler/engine house across Grandview Avenue from the track. The boiler room was south of the engine room, separated by a party wall. Each of the engines was in direct line with the incline plane track. The cables were supported on a wooden truss structure that carried the cable across Grandview Avenue. The engineer who ran the system sat in a glass-frame cab, today called a pulpit, overlooking the whole length of the incline plane (People's Monthly). The engineer used levers to control the steam line to the engines and the air brake. R. J. Smith, a local carpenter, constructed the upper and lower stations; Endres probably was the designer. No description of the original upper station survives. It must have been a fairly temporary construction as the stone foundations were added in 1874, four years after the building was constructed. An 1871 engraving of the lower station shows an end gable, three-bay by three-bay building with center door on Carson Street. A gabled monitor at the south end of the building may have related to the bell departure signals for the incline cars (People's Monthly). In 1872, the lower station received a second-story board meeting room that was wainscotted and trimmed in black walnut and yellow pine. John J. Endres designed the addition.

Price & Long of Philadelphia were the manufacturers of the incline plane cars which cost $3057. They were particularly interesting to a journalist who described the system in 1871, adding an engraving of a side elevation of a car. Each of the two compartments held eight passengers with seating on the uphill and downhill side of each compartment. The compartments were stepped, like the present cars, with the floor of the uphill compartment three feet higher than the floor of the downhill compartment. The bed of the car was at the angle of ascent, 35 degrees, while the floor of each compartment was level. The car had front and rear windows, a four-panel door flanked by single windows for each compartment, all in a simple Queen Anne style. On the uphill side of each car was a hinged pull down "seat" that could be lowered to carry packages as large as a barrel of flour (People's Monthly).

Almost immediately upon completion of the incline plane, changes and adaptions were made to the buildings, tracks, cars and drive system. The water available on Mount Washington had many impurities from the coal deposits near the water source. These impurities corroded the boilers, necessitating their replacement in November, 1872. The new boilers were Withrow Douglass patent upright boilers, made by the manufacturer of the original boilers. Withrow Douglass, a resident of Mount Washington, was a founding member of the Board of Directors of the Monongahela Incline Plane Company (Edwards). In July, 1880, The Iron City Bridge Company, under the direction of C. J. Schultz, provided drawings and specifications for an iron "Derrick" or truss to replace the wooden one across Grandview Avenue. The truss bridged Grandview Avenue with a clear space for street traffic about fifteen feet high. The drive cables were carried from the boiler house to the front facade of the upper station across pulleys on the top of the truss, about twenty-two feet above the roadway. A new safety wheel and cars that could accommodate sixty passengers were also discussed.

In 1881, Samuel Diescher, a civil engineer who had worked for Endres, prepared "a general plan to rebuild the upper portion of the plane now on wooden trestles...and make changes in the upper station" (Monongahela Incline Plane Company). The new road bed would be an iron trestle with steel rails. Diescher provided plans for a new safety wheel, increased the size of the safety cable to 1-1/4", and wanted a "steam chest" to get greater power out of the engines. A constant engineering problem of passenger incline planes was the need to have immediately available large quantities of steam pressure from a hand-fed coal-fire steam system. The "steam chest" was an accumulator that would hold reserve pressure for those times when steam pressure was lost too quickly. The Board of Directors agreed to build a new upper station. The repairs and modification of the passenger incline cost $23,832 and were completed in 1882.

Diescher's modifications included important road bed changes made possible by new advances in iron and steel technology and manufacturing. The lower portion of the incline plane that bridged the railroad was built of 5' plate girders in spans of 60' for approximately 250', the work of C. J. Schultz, the builder of the iron work "Derrick" that crossed Grandview Avenue. The remainder of the plane was constructed of 15" I-beams supported by iron piers and posts. The new rail was 45 pound per yard steel T rails. The engines continued to be the two cross-linked steam engines built by J. & J. B. Milholland of Pittsburgh. Each car had a separate hoisting rope of 1-1/4" diameter crucible steel and a separate drum of cast iron, 8'-10" diameter. Because the hard iron surface of the drums would have abraded the cable, the drums were fitted with wooden lagging placed like staves of a barrel with a plain, smooth surface to

improve the hoisting surface of the cable. The safety cable was the same size as the hoist cable that passed around a single guidance idler or sheave in the engine house. This safety system has continued in use until 1993 and has been describe as part of the existing conditions covered earlier in this report. The cable supports on the track were made of gum wood. The car speed was about 600 feet per minute (American Street Railway Association).

The success of the passenger incline was immediate. The directors found the use so frequent that they undertook street repairs to give passengers better access. In 1871, they had plank laid in Carson Street as a safe walkway crossing the muddy street. Two years later, the board discussed the grading and leveling of High Street (Grandview Avenue) near the upper station. Several months later, they participated in the improvement of Washington (Wyoming) Street.

During the modification of the passenger incline plane, the Monongahela Incline Plane Company discussed construction of a freight or vehicle incline plane adjacent to the passenger incline plane. The expansion of residential development on Mount Washington encouraged this transportation system to carry lumber and other building materials for residential and commercial expansion, groceries, coal and other merchandise for Mount Washington merchants, and roadway and paving materials for construction of new streets.

As in the earlier plan for the passenger incline, the decision to build came before the site was selected. J. L. Kirk, surveyor, looked at the land fifty feet east and fifty feet west of the passenger incline, recommending the eastern site where allowance needed to be made for the incline to pass over the railroad cars and track of the Panhandle Railroad. The Board of Directors engaged John J. Endres as engineer for the project. He was the first choice of the President of the Board of Directors because of his success with the initial construction of the passenger incline. He also was well known to the chief engineer of the railroad and therefore could negotiate purchase of the right-of-way for the freight incline at a reasonable price where the Monongahela Incline Plane Company had failed. Endres negotiated purchase of the thirty foot right-of-way of the passenger incline and fifty feet for the freight incline with rental of additional land farther east for access to the freight incline (Monongahela Incline Plane Company).

The freight incline construction was somewhat more complicated than the construction of the passenger incline. The upper end of the incline terminated at the corner of Wyoming Street and Grandview Avenue at the lip of the escarpment. This necessitated construction of the engine house under the street road bed with eleven brick arches supporting iron girders and the city street.

Construction [illegible] was hampered by the proximity of the coal tunnel of the Castle [illegible] Coal Company. The tunnel and the engine house needed to be reinforced with concrete arches placed over the coal tunnels and lateral concrete walls to transfer the load of the engine house. Steam was piped from the boiler house used by the passenger incline plane on the corner of Wyoming and Grandview. Endres recommended the old boiler house be fitted with double flues for a battery of two new boilers to be purchased as the additional steam plant for the freight incline plane. Further, William Minnsinger, the excavating contractor, needed to remove more dirt and haul it off the site than was initially planned. The cost of the freight incline rose to $115,643.95, exclusive of real estate, nearly $16,000 more than the initial estimate.

The operation of the freight incline was similar to that of the passenger incline except that it carried greater loads. Steam drove two hoisting engines of 20" cylinder x 30" stroke, manufactured by Robinson & Rea Company. The two hoisting ropes and the safety rope were 2" diameter crucible steel with two 12' diameter cast iron hoisting drums with wooden lagging similar in design to those designed by Diescher for the passenger incline. The bridge over the railroad was constructed of 5' riveted plate girders fabricated and erected by C. J. Schultz, now of Monongahela Bridge Company. The rest of the structure was 30" riveted girders in spans of 30'. The 10' gauge road bed had 75 pounds to the yard steel T rails (American Street Railway Association). Within two months of the opening of the freight incline on March 31, 1884, the cars or "trucks" had to be rebuilt in iron by a design of C. J. Schultz and Samuel Diescher that would carry a load of 15 tons and had a floor area of 17' x 32'.

Both the passenger plane and the vehicle plane continued to require frequent repairs, painting and adjustments to cars, track, engines and stations. No changes were particularly dramatic, but they included roofs for the vehicle incline plane cars (1889), new doorways and ventilation for the upper engine houses and boilers (1887 and 1889), heavier rails and cross ties on the freight incline (1891), new closing gates for the car doorways designed by Samuel Diescher (1894), etc. The entry to the freight incline, which was a one-story "W" truss sliding gate on an overhead carriage, gained a roof in 1889 so that horses would not be frightened by the steam of the nearby railroad engines. In April, 1887, both lower station gained two gas lights, the upper station received three. Later that year, the directors asked for a gas light in the board room and exterior gas lights for both incline planes. The next large addition to the complex was the replacement of the lower station in 1904 with a brick two-story hip roof structure designed by MacClure & Spahr, prominent Pittsburgh architects. Plans, elevations and sections are housed at the Port Authority of Allegheny County.

Specifications for this building are at the Archives of Industrial Society, University of Pittsburgh. While most of the proposed plan was constructed as designed, the elaborate and elegant one-story iron and stone gates designed for the entry to the vehicle incline plane were not constructed.

In 1935, the Monongahela Incline Plane Company dismantled the vehicle incline plane and again modified the passenger incline plane. Seeking to open the space across Grandview Avenue and remove the iron "Derrick," the company purchased from Otis Elevator Company the electric drive system describe earlier in this report. This elevator-type drive system was installed in the lower floor of the upper station directly beyond the end of the incline plane track.

The Port Authority of Allegheny County made further improvements in the system in 1982 when the cars bodies were replaced, handicap access provided and both stations renovated and the trestle that supports the road bed changed to concrete piers with steel structure. Complete drawings for this renovation are housed at the Port Authority of Allegheny County Records.

The Port Authority intends to further change the incline plane in 1993-1994 through designs and engineering by Baker and Associates of Beaver, Pennsylvania. The motor generator, main drive motors and primary braking systems will be replaced. The new motors will be 75 horsepower, direct current motors. The bull wheel assembly will be replaced with an assembly that utilizes two sheaves with double cable wraps. A new cable adjustment system will be installed. New security and fire detection will be added. New handicap access will be installed with alteration to both upper and lower stations. The exterior of the upper station will be renovated with a queuing room wing added. The access doors to the cars in each station and the car doors will be changed. The incline plane track will be lit along the entire length of the track.

John J. Endres designed both the passenger and the vehicle inclines built by the Monongahela Incline Plane Company. Endres was born in Prussia where he received his training before moving to Cincinnati, Ohio. In July, 1868, he submitted a plan to the Pittsburgh group interested in building the Monongahela passenger incline plane. His plan was adopted from at least seven submitted designs solicited from Chicago, New York, New Orleans, Newark and other cities. Endres moved to Pittsburgh to supervise the construction. He was paid company stock and $2204 for his design and supervision. As an assistant, he brought another European-trained engineer, Samuel Diescher. Company advertising called Endres "a civil and mining engineer of celebrity." The year following the opening of the Monongahela incline plane, 1871, another Endres design, the Mount Oliver Incline Plane,

opened farther east on the south bank of the Monongahela River. Endres was asked to design the vehicle incline plane for the Monongahela Incline Plane Company in the summer of 1882, even as Samuel Diescher was working on the renovation of the passenger incline plane. During the construction, the minutes of the Board of Directors notes that Endres was in "chronic financial difficulty," frequently sought advances on his pay and, finally, "at the end of summer (1883) abandoned the incline plane job." (Monongahela Incline Plane Company). No record of later Endres engineering work is currently known.

Samuel Diescher, Endres' young associate on the earlier Monongahela passenger incline plane, designed and supervised the remodeling that took place in 1882. Diescher was born in Budapest on July 25, 1839. He was educated at Karlsruhe Polytechnic College and the University of Zurich. He came to Cincinnati in 1866 where he was involved in the design and/or attempts at construction of a passenger incline plane that was not completed. Following his marriage to Endres' daughter Caroline, he worked with Endres on Pittsburgh incline planes and the construction and design of machinery for washing coal. By the early 1880s, he was in private practice in Pittsburgh where he designed passenger and vehicle incline planes, street railways, steel plants, machinery for a number of different industrial tasks and the mechanism for the Ferris wheel at the 1893 Chicago Columbian Exposition world's fair. For the Monongahela Incline Plane Company, Diescher's renovation converted the wooden and iron roadbed to steel rails and iron trestles, improved the efficiency of the engines, replaced the safety cable and built a new upper station. Diescher also improved the designed of the iron cars for the vehicle incline. He consulted infrequently to the company on engineering problems for several decades. He died in Pittsburgh in 1915.

Diescher was designer of the Duquesne (1877), Fort Pitt (1882), Penn (1883), Troy Hill (1887), Nunnery Hill (1887), Castle Shannon #1 & #2 (1890, 1892), and Clifton (1895) incline planes. He also designed incline planes at Johnstown, Pennsylvania; Duluth, Minnesota; Cincinnati, Ohio; Orange, N. J.; Wheeling, West Virginia and Hamilton, Ontario (History of Pittsburgh and Environs). He was a founder and president of the Engineers' Society of Western Pennsylvania (1882).

MacClure and Spahr, architects of the lower station constructed in 1904, were the principals of a prominent Pittsburgh architectural firm. Colbert A. MacClure and Albert L. Spahr each attended the architecture school of the Massachusetts Institute of Technology in Boston. In 1896, Spahr won the medal of the Beaux Arts Society of New York which enable him to travel in England and France. Both he and MacClure worked for Peabody and Stearns in Boston prior to MacClure's coming to Pittsburgh to

open a branch office of Peabody and Stearns in the 1890s. In 1901, both architects left the Boston firm to establish their partnership in Pittsburgh. The firm is best known for its neoclassical buildings including the Union National Bank, Keystone Bank and Diamond National Bank, all in Pittsburgh. After MacClure's death in 1912, Spahr continue the firm (Pittsburgh Index).

The founders of the Monongahela Incline Plane Company were men of prominence in the industries located on the south side of the Monongahela River. Other founders lived on Mount Washington. James M. Bailey, the initial president-pro tem, and William M. Lyon, another director, were principals in the Sligo rolling mill, located next to and across Carson Street from the incline plane lower station. One of Pittsburgh's oldest rolling mills, Sligo was a part of Lyon, Shorb & Company, then Phillips, Nimick & Company. It occupied eight acres in 1879, employing four hundred men. It was among the largest rolling mills in Pennsylvania. Bailey lived on Mount Washington where he owned an extensive estate. In 1872, William Lyon lived on the north side of Grandview Avenue, overlooking the Sligo rolling mill. He owned the right-of-way of the passenger incline from Grandview Avenue to the railroad grade. Withrow Douglass, a director, manufactured the original boilers, patented the replacement upright steam boilers. He lived on a large property on Mount Washington. His factory, W. Douglass & Sons, was across Carson Street from the incline plane, east of Lyon, Shorb & Company. Joseph Dilworth and D. W. C. Bidwell, founding directors, were in the black powder business as agents of the DuPont Company during the Civil War. Joseph Oilworth and his brother William, both owners of company stock, were life-long residents of Mount Washington with extensive land holdings. William was a principal in the largest railroad spike mill in the United States, located on Pittsburgh's south side, east of the incline plane. William Halpin, a director who lived on Mount Washington, was a principal in Halpin & Humbert, plumbers, gas and steamfitters who supplied material for construction of the upper and lower stations. Halpin owned a large property several blocks from the upper station. Another directoe, Frederick Kauf, had a grocery and produce business on St. Clair Street (Shiloh) in Mount Washington near the upper station of the incline plane. Thomas Grundy was a carpet weaver located on Sycamore Street in Mount Washington. Samuel Harper, a founding director and president during the construction of the vehicle incline plane, was a bankruptcy attorney who lived on Grandview Avenue just west of the upper station. The early board secretary, John L. Awl, lived on the old road up Mount Washington. Joel L. Bigham, an attorney and another early director, was heir to about a quarter of the land on Mount Washington through his grandfather, who was the first resident of the hilltop.

In addition to relying on local financiers for funding and local engineers for the incline plane design, this incline plane used locally manufactured products and supplies. The boilers were fired with Castle Shannon coal dug in the tunnels under the upper station on Mount Washington. J. & J. B. Milholland, supplier of the original engines for the passenger incline, was a prominent Pittsburgh foundry located north of the Monongahela River. Robinson, Rea Company, supplier of the engines for the vehicle incline plane, had its factory on Carson Street east of the lower station, just past the approach to the Monongahela Suspension Bridge. The Sligo rolling mill supplied much of the boiler plate iron for the original passenger incline plane. Bridge work came from C. J. Schultz, proprietor of the Iron City Bridge Works, another south side business. Schultz also was president of the Mount Oliver Incline Plane Company, constructed in 1871. The signal bells for the incline came from A. Fulton's Son & Company, Pittsburgh's only manufacturer of brass bells. Other goods needed for construction, maintenance and operation of the incline plane were readily available in Pittsburgh.

An 1871 article notes that the wire factory of Pittsburgh bridge engineer John Roebling supplied the cable for the original incline plane construction. The company minute books and payment records surprisingly do not mention the name of the cable maker. Seven months after the incline plane opened, in December, 1870, Charles Copeland & Bros. sued the company for patent infringement on the cable design of the safety cable. The previous year, Copeland, an engineer working in New York City, had submitted a design for the incline. By the date of the law suit, Copeland and his brother were living in Pittsburgh where they continued to manufacture wire rope into the 1880s. Apparently Copeland's patent rights had been violated as the Monongahela Incline Plane Company paid Copeland a $250 settlement in 1873 and the cost of the patent infringement continued to be negotiated until 1877. Yet another Pittsburgh cable manufacturer, Mason & Son, provided the earliest purchased replacement cables in the summer of 1871 (Monongahela Incline Plane Company). In 1896, Samuel Diescher told the membership of the Engineers' Society of Western Pennsylvania that he only used crucible steel cable manufactured in England; American steel was not the same quality.

The passenger incline initially employed an engineer and an assistant engineer to drive the system at the upper station and a conductor to collect the toll and secure the car doors at the lower station. The employees for these jobs were selected annually by a vote of the members of the Board of Directors and were required to post a $1000 bond. With several years of service and the enthusiastic support of regular customers, employees were fairly assured "re-election." In 1870, the engineer and conductor worked from 6 a. m. until 11 p. m. A watchman and a fireman worked fifteen hours each. After the

construction of the vehicle incline plane, the passenger incline plane workday was two twelve-hour shifts with trips every five minutes during the day and every fifteen minutes evenings and nights. The vehicle incline worked one twelve-hour shift, running whenever requested. The first engineer was George Naysmith, recommended by John Endres; assistant engineer was Campbell K. Smith; the conductor's name was not given. Through 1900, employees were Anglo-Americans. In 1872, the fireman and laborer received $65 per month, the assistant engineer received $85 per month and the conductor received $70 per month. The business minutes do not mention the salary of the engineer. Employee payment fluctuated according to changes in the local economy. After the Panic of 1873, monthly pay decreased. In 1883, when the Penn incline plane hired away the Monongahela engineer Halton, the riders protested and the directors raised his wage to $90 a month. At the same time, John H. Reed ran the newly opened freight incline plane for $80 per month and Seth Lowman was freight incline conductor for $60 per month. At this time, the freight incline plane ran from 6 a.m. until 7 p.m., daily (Monongahela Incline Plane Company).

The passenger incline plane fare, at the time of opening, was 6 cents, a family ticket of 125 rides was $5, a school ticket was 33 rides for $1 for children under 10 going to and from school and children under 5 were free with an adult. Tickets were sold at the top and bottom initially, later payment was made only at the bottom. Rides were signalled by a single bell for loading a car, two bells when the car was ready and the door closed by the conductor and three bells for the start of the ride. Passenger fares fluctuated with the economy, decreasing after the Panic of 1873. Fares also responded to competition, dropping after the success of a beer garden constructed near the upper station of the Mount Oliver incline plane (Monongahela Incline Plane Company).

The same method of bell signalling was used by the freight incline plane as that for the passenger incline plane. At its opening in 1883, its fares were 15 cents for a horse and rider or a horse and buggy, 25 cents for a horse and wagon and 40 cents for a two-horse wagon. Initially, wagons carrying slag for the streets of Mount Washington were charged no fee. By 1886, with ridership fairly stagnant for a year, slag wagons were charged half fee. The directors felt that good roads would attract new residents to Mount Washington. Five years after its opening, the freight incline ran on Sundays accommodating passengers and vehicles while the passenger incline was closed for the day.

An 1852 map of Pittsburgh, prior to the opening of the incline plane, shows West and East Carson Street with six large factory buildings and a coal railroad from Mount Washington near the present site of Duquesne Incline Plane. Buildings, probably

residential tenements, line West Carson Street near the two rolling mills, but the area has no social or commercial nodes either at the entry to the Monongahela Suspension Bridge or farther west along the river bank. Churches, schools and more worker tenements came with the expansion of the heavy industries.

In 1872, shortly after the opening of the passenger incline plane, the land east and west of the lower station held many noisy, smoky and noxious industries: the Clinton and Sligo rolling mills, a white lead works, a boiler maker, engine maker and other foundries, a sawmill, a flour mill, five glass factories, two coal inclines, a coal loading yard and the main line of the Panhandle Railroad. The area had become enough of a neighborhood to hold the social and community services for the nearby worker housing. Between the Clinton and Sligo rolling mills, west of the incline plane, was wood frame St. Malachy Roman Catholic Church, the brick Monongahela Borough public school and a number of commercial buildings. At the intersection of the path that led up Mount Washington (later Sycamore Street), the approach to the Monongahela Suspension Bridge (later Smithfield Street) and Carson Street were a lawyer, a doctor and two hotels, the railroad passenger station and other railroad facilities for the Panhandle railroad and other commercial uses. Housing on this part of the south side consisted of a few free-standing wooden residential buildings and company-owned, usually wooden, row house apartments or tenements. For the Clinton rolling mills, nineteen two-story tenements faced each other across Carson Street with another row of two-story row houses as back houses near the Mount Washington escarpment. The Sligo rolling mill had twenty-five 2-1/2 story tenements on the north side of Carson Street backing onto the mill storage yard. Another "street" of tenements ran north from Carson Street with a thirty-five-foot common space between the seventeen buildings. William McCully & Company window glass manufacturers had thirty-seven tenements in four groups of row houses on the Carson Street side of their factory site. Most of the tenements continued in use along Carson Street into the 1900s.

From 1879, the Pittsburgh & Lake Erie Railroad (P. & L. E.) had a presence on the south bank of the Monongahela River, hauling coal and coke. By 1884, a round house and locomotive erection shop was located behind the brick Sligo mill housing that faced Carson Street. This railroad had taken over the boilermaker foundry and white lead smelting works for the site of its freight and passenger stations, at the northwest corner of Carson and Smithfield Streets, across from the Monongahela incline plane lower station and entry to the vehicle incline plane. Responding to the railroad expansion and the construction of a new bridge to replace the Monongahela Suspension Bridge, the Carson Street/Smithfield Street intersection was becoming more of a commercial center with three hotels, livery stables, drug stores

and more small shops and the passenger station for the Panhandle Railroad, called Birmingham Station, on the south side of these shops, facing the road to Mount Washington, Sycamore Street, and the escarpment.

Through the 1890s, the P. & L. E. continued to expand, moving its freight yard to the east side of Smithfield Street behind the stores and hotels. The Panhandle Railroad passenger station continued behind the stores on the south side of Carson Street. In 1898, the P. & L. E. constructed its seven-story, brick and terra cotta, neoclassical passenger station and offices facing east on Smithfield Street with train sheds behind, along the railroad tracks and Monongahela River. About two hundred feet west of these train stations on Carson Street was the freight incline lower entry and the passenger incline lower station, across from a new P. & L. E. freight warehouse built in 1903.

In 1904, the P. & L. E. continued clearing buildings from the Smithfield and Carson Streets intersection, opening the freight yard east of the Smithfield Street Bridge to Carson Street. By 1910, the glass works, the foundries, and the Sligo rolling mills with their tenements were gone, taken by the expansion of the P. & L. E. The Clinton mill tenements not only stayed, but were expanded behind the residences near St. Malachy and the school, now a warehouse. In 1913, the P. & L. E. built another large warehouse along Carson Street just west of the entry to the incline planes. The properties along the south side of Carson Street east of Smithfield had undergone redevelopment but still continued as commercial properties.

The architectural character of the Carson and Smithfield intersection has changed little since about 1915 except for the removal of commercial buildings on the south side of East Carson Street near Smithfield. The Monongahela incline plane continued to carry commuter passengers from their residence on Mount Washington to work in Pittsburgh. However, the social character of the area changed with the abandonment of passenger rail transportation on the south side and other changes in the railroad industry. In 1976, Pittsburgh History & Landmarks Foundation commenced the redevelopment of the P. & L. E. site into an commercial and office site, renaming the area "Station Square." The popularity of Station Square has generated increased passenger usage of the Monongahela incline plane as a tourist attraction. Bus and trolley service, located on the site of the Panhandle passenger railroad terminal, has responded to the need for increasing public transportation by both tourists and commuters in the 1980s and 1990s.

As early as 1852, Mount Washington streets near the escarpment were platted into fifty foot town lots, but had gained six houses along Grandview, and few along Sycamore and Virginia between

Wyoming and Merrimac. These streets were among the few on Mount Washington. Lots filled slowly with wood frame residences in the years prior to construction of the incline plane. No particular center to the borough appeared with Grace Episcopal Church found on Bertha Street toward the west, the Presbyterian church on Kirkpatrick (Kearsarge), a school on Sycamore Street, and the post office on Sycamore at St. Clair (Shiloh).

In 1872, a defined commercial area for the borough residents was still not apparent. The north side of Sycamore Street had few houses as it was the back of the lots on Grandview Avenue. Dilworth, Bigham, Bailey, Douglass and Cowan, all investors in the incline plane, had substantial undivided acreage. In the late 1860s, borough population was about 2,000.

Like all the eleven boroughs along the south bank of the Monongahela River, Mount Washington became a part of the city of Pittsburgh in 1872. Two years after the completion of the passenger incline plane, the area had enough population to become the thirty-second ward. Virginia and St. Clair (Shiloh) Streets were gaining housing. Land was being subdivided in anticipation of residential expansion. Slowed by the Panic of 1873, Mount Washington none-the-less had nearly doubled its population to 3,745 between the late 1860s and 1882 (Lawther). Clearly the construction of the incline plane created a business climate that could more closely tie Mount Washington and the south bank of the Monongahela River. Examples of Mount Washington business expansion generated by the incline plane exist. A. W. Smith, a market gardener who grew mostly lettuce before 1870, increased his business to more perishable cut flowers which he supplied to much of Pittsburgh after the reliability of incline plane transportation was assured (Bothwell).

During the prosperous years before the Panic of 1893, building permits for Mount Washington reached a high of 138 permits issued in 1892. By 1882, large tracts were subdivided between Bedford and Natchez Streets, sixty-six lots, and between Natchez and Prospect Streets, seventy-nine lots. From the beginning of building permit records 1877 until 1909, 2,273 permits were issued for construction of buildings on Mount Washington. After 1890 a business area became more defined with banks and other brick commercial buildings, a library on Shiloh Street and churches on Sycamore. These two streets were served by a trolley system in 1897. Until a trolley system reached the south side of Mount Washington through a tunnel from Carson Street, residential density continued to be concentrated near the escarpment and the Monongahela and Duquesne incline planes, with most easily buildable lots filled by 1910.

The most important secondary intent of the founders of the Monongahela Incline Plane was the suburban development of Mount

Washington. Many founders owned large tracts of open land, others were associated with mercantile establishments that would profit from access to a wider buying public. Residential streets nearest the Monongahela incline plane were the first to become densely settled. The number of building permits rose dramatically after the construction of the freight incline plane. From its early operation, the freight incline had a reduced fee for certain products to encourage increasing loads of building materials and coal (home heating fuel). The president of the Board of Directors noted that lower fees "means more houses and customers." Residential and commercial construction, according to Lawther, was largely speculative, undertaken by building companies or individual contractors who built for resale. Only 23% of construction between 1884 and 1901 was undertaken by home property owners for their own residences (Lawther).

The founders and directors of the incline plane were also interested in tourism. In August, 1872, the track was lined with two hundred Chinese lanterns to further enhance the popular ride up and down for persons attending a soldiers and sailors convention. Two years later, the board established a committee to purchase or lease a picnic grounds with special round-trip fees for church groups of at least one hundred picnickers. Several years after the completion of a pavilion near the upper station of the Mount Oliver line (about 1874), the Monongahela Incline Plane Company flirted with construction of a similar attraction. A roller skating arena was mentioned. When the Penn incline profited from a "resort" at the top of the line, the idea of a similar amusement was revived and again rejected, "at this time" (1884). Tourism continued to draw ridership during the twentieth century, boosted in the 1960s with the construction of a hotel/motel with restaurant just east of the site of the freight incline. This five-story building attracted national attention with a story in The New York Times.

Income of the Monongahela Incline Plane Company steadily and consistently increased during the early decades, showing profit for every year through 1910. Ridership and residential development on Mount Washington was far more reflective of the economic swings of the Pittsburgh industrial economy. Ridership fell off after the Panic of 1873, not passing the 1873 figures until 1880. Records of building permits begin in 1877, but they too reflect the slow recovery after the depression. The Panic of 1893 dramatically affected Mount Washington growth as reflected in the number of building permits issued, but little affected the numbers of users of the incline planes.

This incline plane and the fourteen others in Pittsburgh enjoyed success as long as workers relied on pedestrian transit enhanced by easy access to inclines. By 1897, street cars passed east and west on Carson Street and across the Smithfield Street Bridge to

downtown Pittsburgh. Further, the Pittsburgh and Mount Washington Electric Street Railway Company provided service to the densely settle area at the top of the incline on Grandview and Virginia Avenues and Wyoming Street. Mount Washington streets more than a mile from the incline on the south side of the hill developed dense residential housing only after trolley access via a tunnel under Mount Washington was constructed in 1901.

When other means of transportation became available and new routes to suburban areas beyond Mount Washington were constructed, Pittsburgh workers moved to newer housing built farther from the center city. The Liberty Tubes, opened in 1924, gave access to the South Hills area, a new suburban area beyond Mount Washington. Preference of automobile transportation reduced incline ridership in many areas of Pittsburgh. For the Mount Washington neighborhoods, the incline was the most direct transportation system to the city until the Mount Washington Roadway, or P. J. McCardle Road, was constructed. When it was completed in 1928, it gave car and truck access from Tenth Street near Carson to Grandview Avenue at Merrimac, cutting into the escarpment of Mount Washington and running under the Monongahela incline plane. With this road, few Mount Washington residents needed to rely solely on either the Monongahela or Duquesne incline as their exclusive method of transportation. The easier transit of large and heavy goods on the roadway made the Monongahela vehicle incline plane obsolete. The passenger incline became a secondary, quick means of access between Mount Washington and Smithfield Street. Its popularity as a tourist attraction has increased.

SOURCES OF INFORMATION

A. Engineering drawings:

Engineering and architectural drawings for the lower station in 1904, upper station motor room renovation in 1935, new cars in 1982, track renovation in 1982 are in the records of the Port Authority of Allegheny County.

B. Historic views:

The photograph archives of the Pennsylvania Room in the Carnegie Library, Historical Society of Western Pennsylvania, Archives of Industrial Society at the University of Pittsburgh Library, Pittsburgh History and Landmarks Foundation, Architectural Archives of the Hunt Library of Carnegie-Mellon University, and the Library of Congress were searched for historic photographs of the incline plane and adjacent properties. Historic photographs were photographed when permission to photograph was given. The Carnegie Library, Pittsburgh, and the Archives of Industrial

Society at the University of Pittsburgh Library have copyright restrictions on photographs in their collections. Xerox copies of some of these photographs are included under Graphic Documentation. Historic photographs not copied are listed below.

Photograph, photographer unknown, ca. 1900, A 757, original in Carnegie Library, Pittsburgh, PA.
View southwest from Carson Street, freight incline plane, passenger incline plane, lower station.

Photograph, photographer unknown, ca. 1930, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Freight incline plane from Carson Street.

Photograph, photographer unknown, "Chatauqua Photo Company," ca. 1930, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Freight incline plane, passenger incline plane from Carson Street.

Photograph, photographer unknown, ca. 1963, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Passenger incline plane, lower station from Carson Street.

Steel engraving, 1871, People's Monthly, copy of magazine article in Pittsburgh History & Landmarks Library, Pittsburgh, PA.
Side elevation of passenger incline plane car and view of lower station looking west.

Five photographs, photographer unknown, July 1958, originals in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Replacing car wheels and working on car roof.

Photograph, photographer unknown, 1963, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Changing incline plane car wheels.

Photograph, photographer unknown, ca. 1960, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Changing drive and safety cables.

Photograph, photographer unknown, 1962, original in Monongahela Incline Plane Company collection, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
Using a jib-boom rigged on front of incline plane car.

Photograph, photographer unknown, 1922, original in City Photographer Series collection, 22-1796, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
View south from Smithfield Street, paving Smithfield Street Bridge.

Photograph, photographer unknown, November 11, 1927, original in Pilttsburgh & Lake Erie Railroad collection, 82:23-3426, the Archives of Industrial Society, University of Pittsburgh Library, Pittsburgh, PA.
View east of the East Carson Street P. L. & E freight yard.

Photograph, photographer unknown, June 1972, original in Carnegie Library, Pittsburgh, PA, "Grandview Avenue, Mount Washington Centennial."
View southeast on Grandview Avenue near Shiloh Street.

C. Interviews:

David Miller, President of Society for the Preservation of the Duquesne Incline discussed the engineering of inclines in general, during a lengthy tour of the Duquesne Incline Plane motor rooms.

D. Bibliography:

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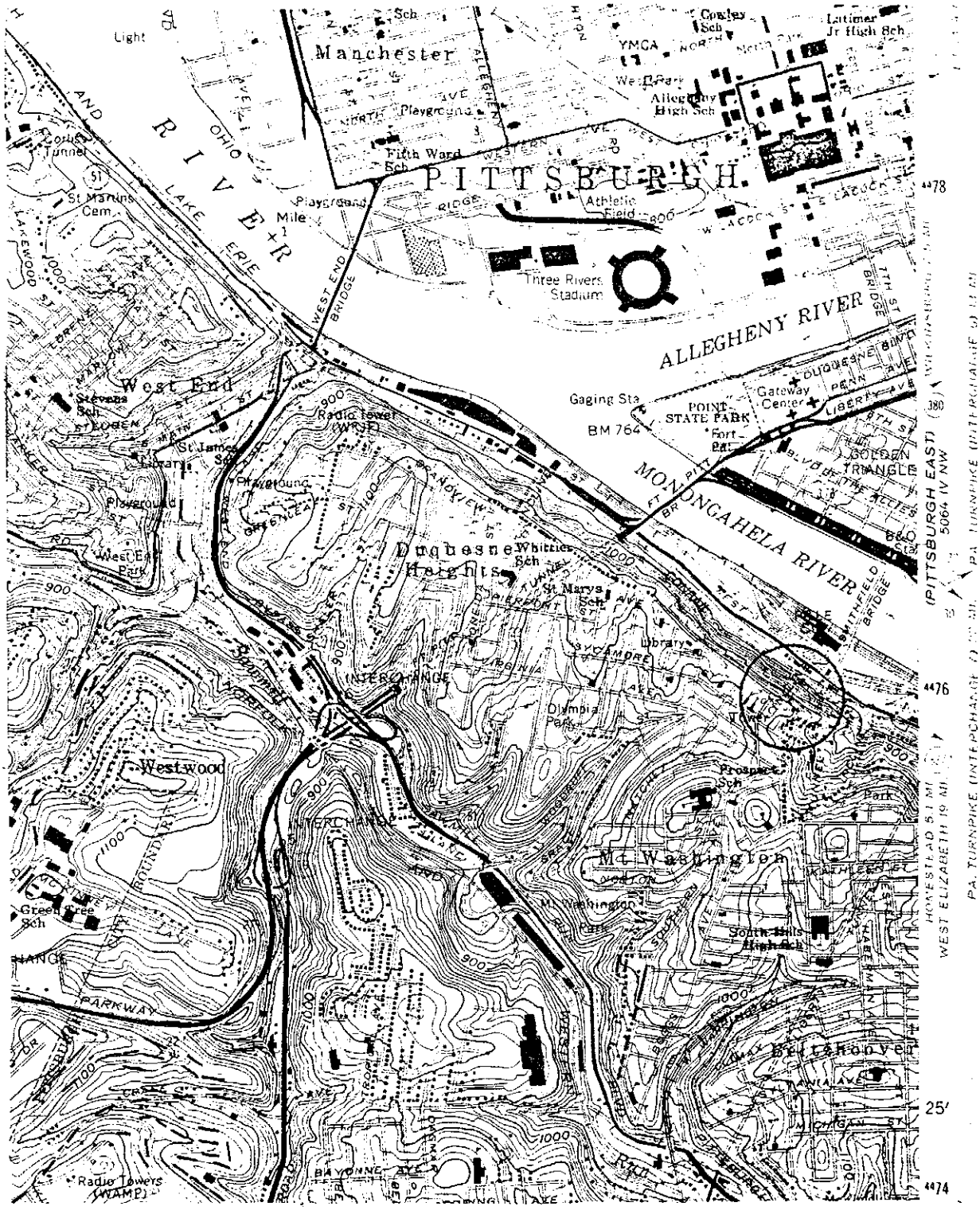
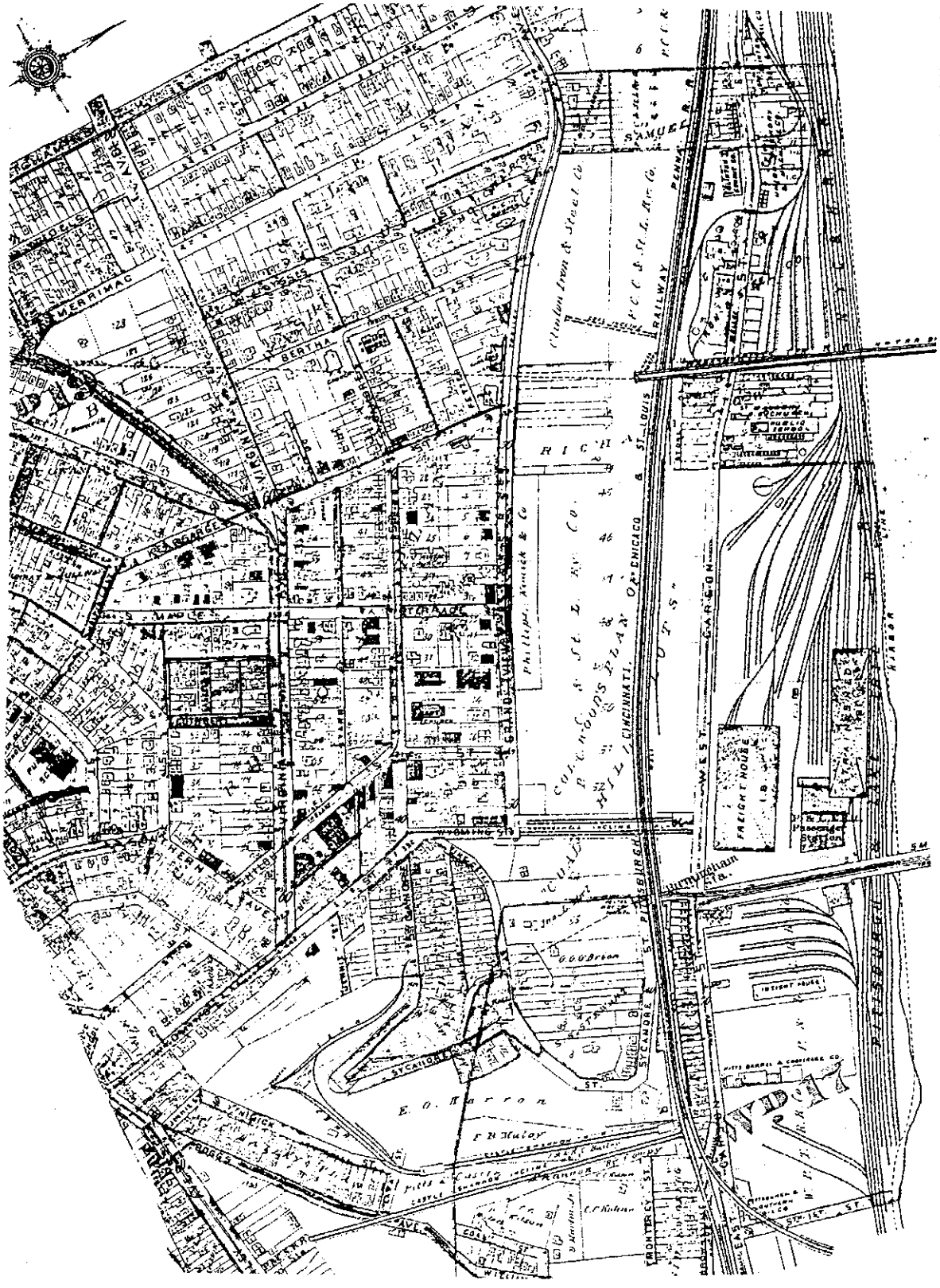


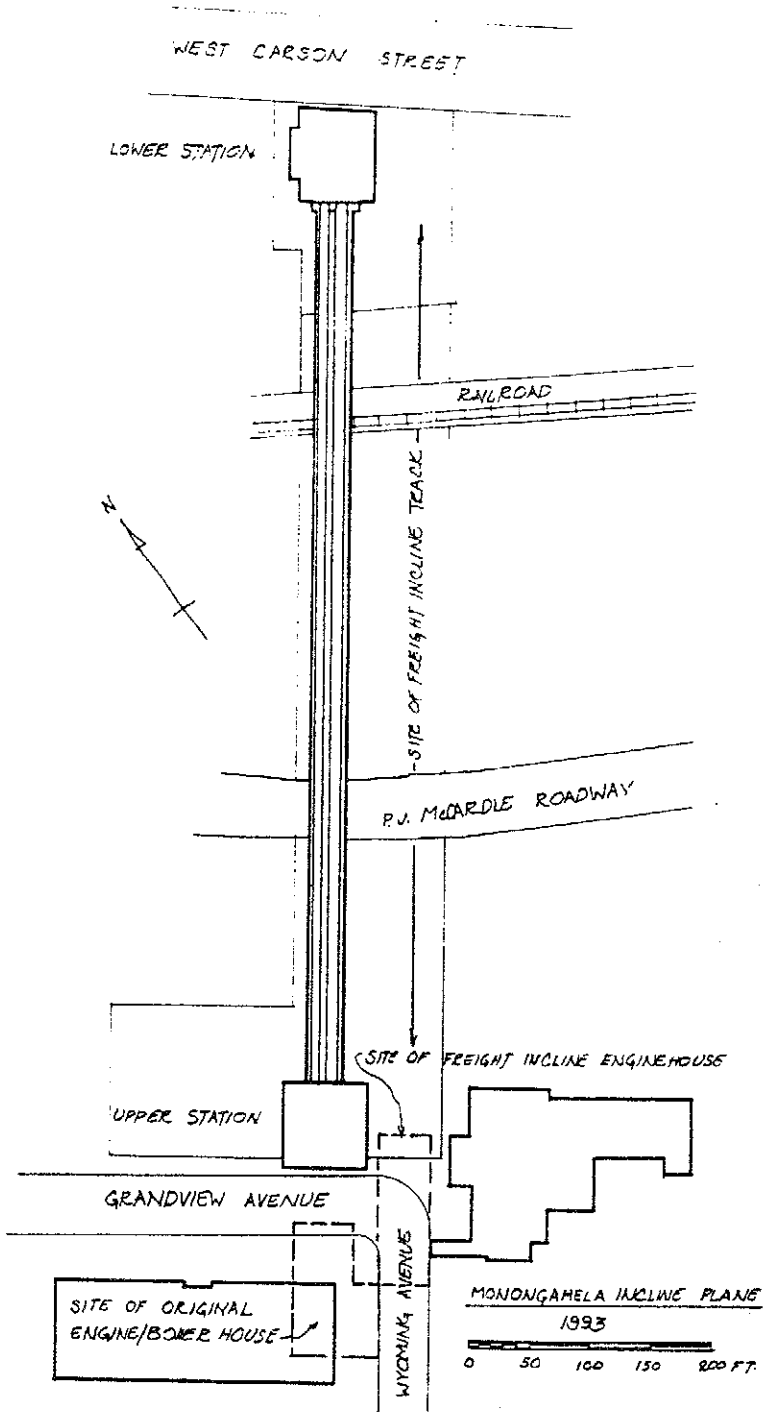
Monongahela Incline Plane.
Pittsburgh, Pa. West, 1960, photorevised 1976 (USGS).

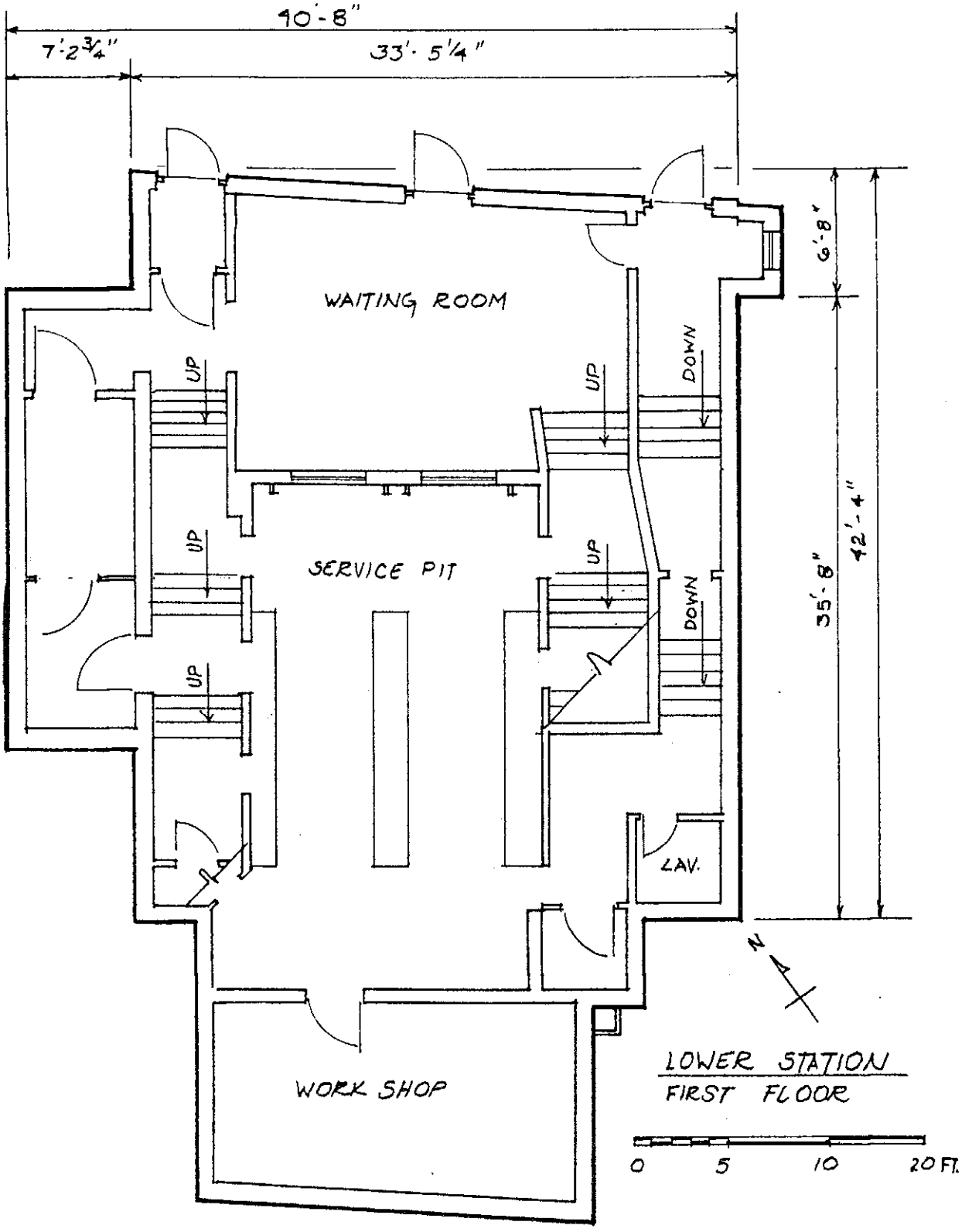
Monongahela Incline Plane environs, 1872 (Hopkins, 1872).

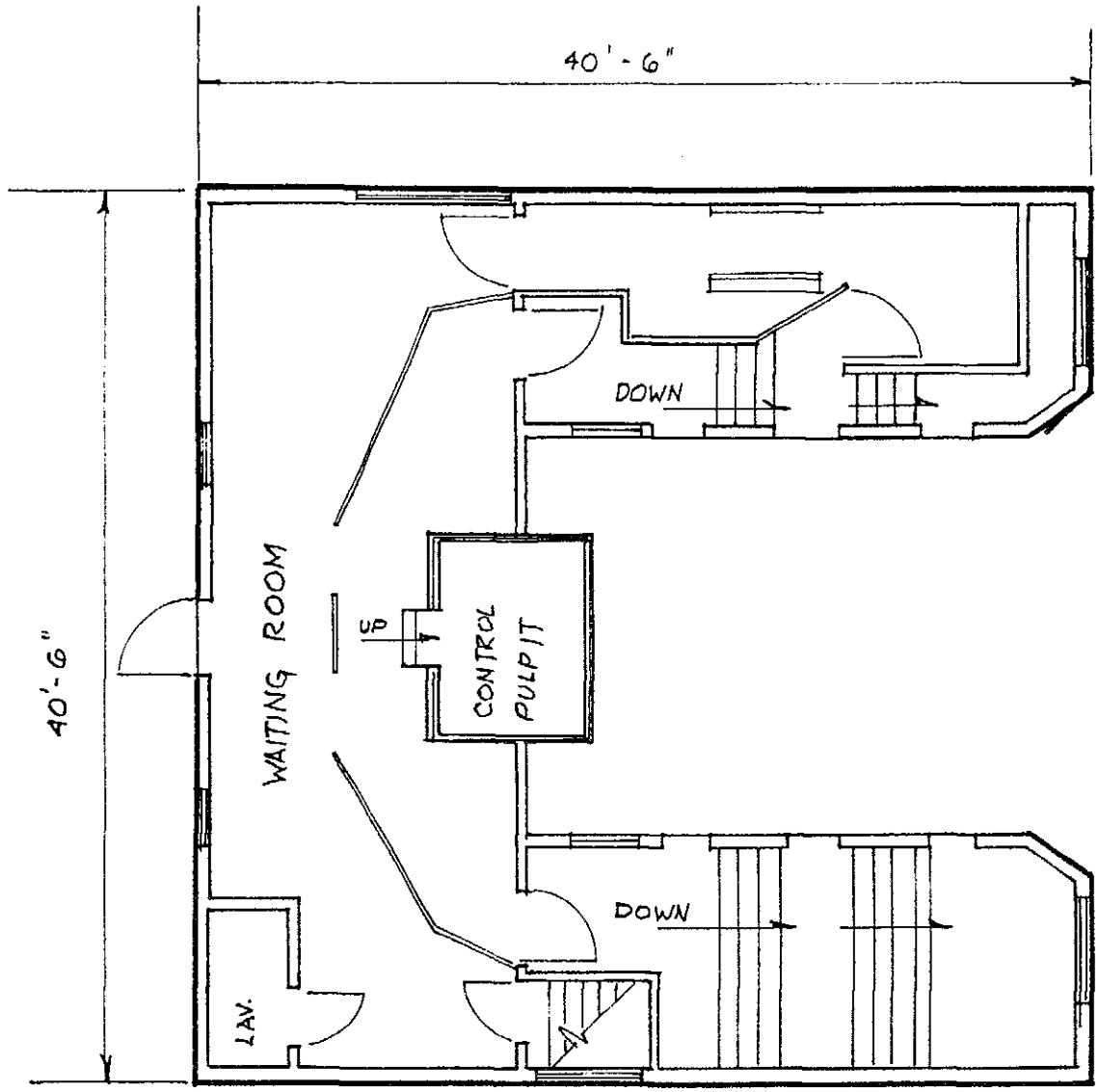
Monongahela Incline Plane environs, 1882 (Hopkins, 1882).



Monongahela Incline Plane environs, 1910 (Hopkins, 1910).

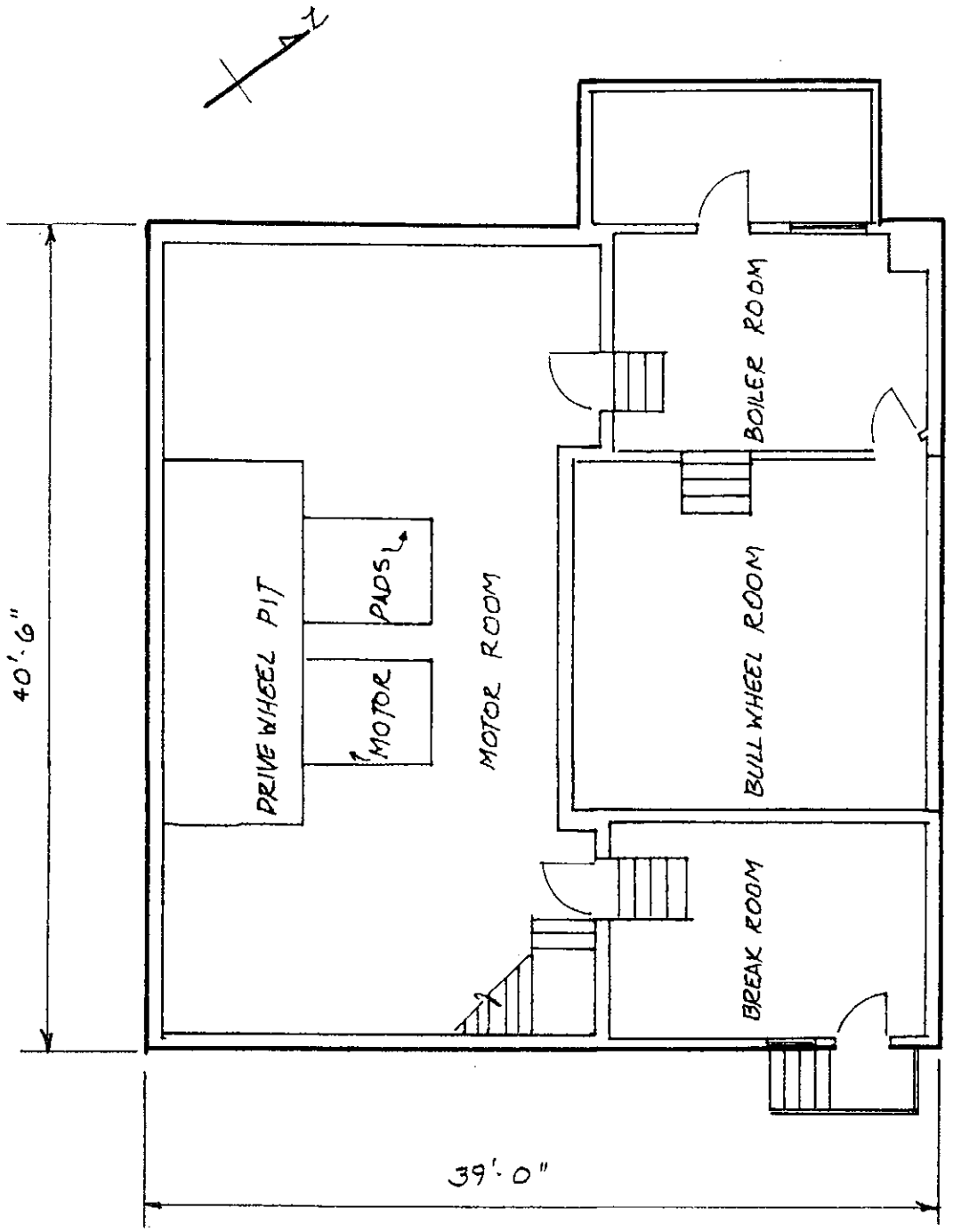

WEST CARSON STREET
LOWER STATION
RAILROAD
SITE OF FREIGHT INCLINE TRACK
N
P.J. McARDLE ROADWAY
SITE OF FREIGHT INCLINE ENGINEHOUSE
UPPER STATION
GRANDVIEW AVENUE
WYOMING AVENUE
SITE OF ORIGINAL ENGINE/BOILER HOUSE
MONONGAHELA INCLINE PLANE
1993
0 50 100 150 200 FT.


40'-8"
7'-2¾"
33'-5¼"
WAITING ROOM
SERVICE PIT
WORK SHOP
LAV.
UP
UP
UP
UP
DOWN
DOWN
6'-8"
35'-8"
42'-4"
N
LOWER STATION
FIRST FLOOR
0
5
10
20 FT.



UPPER STATION—MAIN FLOOR

0 5 10 15



UPPER STATION-LOWER FLOOR

0 5 10 20FT.